# NEWS REPORT

## NATIONAL ACADEMY OF SCIENCES
## NATIONAL RESEARCH COUNCIL

Volume VII, Number 2 MARCH-APRIL 1957

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*NEWS REPORT* is published bimonthly by the National Academy of Sciences–National Research Council. It is designed to report current activities of divisions, boards, committees, and other established groups within the organization, and to record news of cooperating Societies and developments in the field of international science. It is distributed without charge to organizations and individuals directly associated with the Academy–Research Council; it is available to others at the rate of $2.00 per year.

# NEWS REPORT

*National Academy of Sciences National Research Council*

VOLUME VII *March-April 1957* NUMBER 2


## Studies in Prosthetics


F. S. STRONG, JR.

*Chairman, Prosthetics Research Board*


TODAY, although much is being said and written about our crippled and physically handicapped citizens, many of us may still associate their relief and rehabilitation with the efforts of various charitable organizations, foundations, and the like, assuming that when a drive meets its quota somehow a particular problem is on the road to solution. We may feel, moreover, that any direct intervention by society, through government, in these matters might be related to some form of "socialized medicine," and another instance of the erosion of our American way of life. For, though individually the most generous people in the world, most Americans still prefer to maintain independence face to face with their Government and are inclined to look with disfavor upon wholly socialized security and welfare.

But the most rugged individualists among us know that there are certain problems the solutions of which society must seek through government. Public education is the best example; the development of rivers and harbors is another. Still another, though not involving great numbers of our people—less than a million, in fact—has to do with those who have lost arms or legs through accident or disease, or who were born thus handicapped. And this misfortune may run the gamut from loss merely of part of an extremity all the way to the plight of a child entering the world with no limbs at all! What should be done about it?

At the close of World War II the problem of the amputee came in for unfavorable publicity when relatives and friends of our war casualties began comparing the mechanical gadgets in their homes with the equipment offered the boys fresh from battle. Were these artificial limbs the best the leading industrial nation of the world could provide to be fitted to men who had just given important parts of their bodies in the defense of their country? No one thought so. Indeed, had serious thought ever been directed effectively at this complex problem? Accordingly, at the request and under the financial support of interested Government agencies the Academy–Research Council appointed the Committee on Artificial Limbs, and soon a broad study was under way. Paul E. Klopsteg, Chairman of that pioneer group, has told the story of these early efforts in the July-August 1951 issue of NEWS REPORT. Fifteen research contracts soon began to turn up information, sometimes positive, sometimes negative, but all leading to a wealth of data from which have come already many improved devices and techniques for better service to our amputees, veteran and civilian alike.

During the 10 years following the establishment of the original committee in 1945, a period which may now be looked upon as a time of pilot study, a pattern was established for a continuing program in the art of prosthetics. The Academy–Research Council committee system once more showed versatility and competence in helping coordinate the efforts of many toward the solutions of a vexing problem. Public funds and general support seemed assured. Planning for the future could, therefore, be undertaken with confidence.

To make progress possible over the years ahead, the Prosthetics Research Board, successor to the more recent Advisory Committee on Artificial Limbs, was established in December of 1955, with a title suggesting a broader concept of responsibility involving not merely the device as an engineering structure, but rather the man-machine complex as a biomechanical whole. Under the Board specific committees will deal with particular aspects of this field of rehabilitation. The first of these, the Committee on Prosthetics Research and Development, covers essentially the area assigned to the original Committee on Artificial Limbs. This Committee under established transition procedures guides the passage of an accepted idea through development and testing to manufacture and application with the assistance of three "phase" subcommittees responsible for the defining of criteria for design (Phase I), the design and development of working models (Phase II), and the evaluation and testing of production models (Phase III).

In the working out of this method, which has evolved during the 10-year pilot study period, the Board looks first to projects at the University of California where fundamental research is carried out by specialists in the medical and engineering schools. At the University's Medical School in San Francisco, studies in the medical problems of the amputee are supported by grants from the National Institutes of Health, U. S. Department of Health, Education, and Welfare. Here the researchers, divided into small groups, are interested in all aspects of the man to whom the machine is to be added. They investigate, for example, possible improvements in stump surgery which may facilitate the wearing of an artificial limb, as well as how proper post-prosthetic care may contribute to comfort and health. They are particularly concerned with the problem of pain in the amputee and in the effect of increased energy requirements resulting from the use of a prosthesis, especially in the case of the older amputees or those suffering from cardio-vascular involvement. Much more needs to be known, too, about the psychological problems resulting from amputation and prosthetic replacement, particularly as they affect vocational rehabilitation. Furthermore, these and other related studies provide information needed in establishing criteria for the design of prosthetic devices and the perfection of techniques for their application.

Engineering studies, supported by a Veterans Administration research contract under the provision of Public Law 729 (U. S. Code, 1952 ed., sup. 4, title 38, secs. 253–254), are carried out by means of two separate University of California activities, the Lower-Extremity Amputee Research Project at Berkeley and the Engineering Artificial Limbs Project in upper-extremity prosthetics at Los Angeles. The first of these, one of the oldest in the program, has provided much needed information in the field of human locomotion, both normal and amputee, resulting already in important advances in the design of artificial legs. This project, as well as that at the Medical School in San Francisco, is serviced by means of a prosthetics laboratory operated by the engineering group in space provided by the Bureau of Medicine and Surgery at the Navy Prosthetics Research Laboratory, U. S. Naval Hospital, Oakland, Calif.

The Engineering Artificial Limbs Project provides fundamental research data on upper-extremity biomechanics, makes time and motion studies applicable to arm amputees, and considers not only how body power can be harnessed and transmitted effectively for operation of terminal devices, but also what systems of external power may be of value particularly for difficult bilateral cases.

Devices and techniques selected for development by the Committee on Prosthetics Research and Development are assigned to

industrial laboratories (Phase II). Lower extremities are handled by the University of California-Berkeley Department of Engineering, assisted by the Navy Prosthetics Research Laboratory, and upper extremities by the Army Prosthetics Research Laboratory, Walter Reed Army Medical Center, Washington, D. C. "Shake-down" testing is done at New York University under the provisions of Public Law 729 through a contract with the Veterans Administration.

Items approved by the Committee are next moved to Phase III for thorough evaluation and testing by New York University. At this point models which have been developed in Phase II must be production engineered, usually by a manufacturer selected by competitive bidding and careful analysis of ability to make devices under approved specifications for later prescription and use in the prosthetics field. For these purposes funds are provided for purchase of enough units—usually 50 to 100—to enable the manufacturer to make an initial run over production tools and thus be ready to supply the "trade."

Here a word of explanation may illustrate a problem, somewhat peculiar to the "limb business," which has to be overcome in order to assure the kind of service an amputee should be able to expect in our modern world. In the past most amputees, after surgery and normal recovery, have had to shift for themselves, the doctor often having been content with giving his patient on discharge the addresses of two or three "limb shops." The proprietor of the one finally selected may have been an amputee himself who had perhaps been of a mechanical turn of mind, and who, in attempting the solution of his own problems, had gradually worked into the business. Others perhaps made parts. In time some concerns spread out to cover a number of cities, partly through branches, often by mail-order methods. Of course many amputees, before the days of "welfare," found themselves drifting to lower economic strata where they could not afford even the relatively simple and inexpensive devices then available. All in all, this was small, very small business.

Thus, since there is here no broad market in the accepted American concept, with expanding sales supporting ever better products, nor even a government "using service," this problem cannot be solved merely by having the Government underwrite some research and development and provide a few samples of the latest in artificial arms and legs. We must first persuade the doctor to sponsor his patient, not through surgery alone, but on through the various steps of "rehabilitation." There has been developed, therefore, the "prosthetic clinic team" made up at minimum of a physician (chief), a therapist and trainer, a prosthetist or limb fitter, *and* the amputee. Out of their deliberations should come a prescription for the prosthesis. Included may be pre-prosthetic treatment, if indicated, by the therapist. The prosthesis is then assembled and fitted by the prosthetist and "checked out" by the team. After training by the therapist and final evaluation by the team, the amputee is ready to lead a more or less normal life, depending upon the extent of practicable prosthetic replacement. In this not only the doctor, as clinic team chief, but later the rehabilitation counsellor, play important roles, for in helping the amputee they also help create the market the manufacturer must have after the research device has been thought up, designed, developed, made and tested under the Board's procedures.

But this may not happen simply because it should; there is another area of interest guided by the Committee on Prosthetics Education and Information, since doctors, therapists, prosthetists, counsellors, and others need to know about the new methods and devices flowing from the program. Thus, there have been established two Prosthetics Education Projects, one at New York University-Bellevue Medical Center and the other at University of California at Los Angeles Medical Center, where short courses are being offered to existing or future clinic teams. Developed and equipped by the Veterans Administration in space provided by the respective centers, these schools are being supported by grants from the Office of Vocational Rehabilitation, U. S. Department of Health, Education, and Welfare. Plans are also under way to offer courses for rehabilitation counsel-

lors, both Federal and State, and Veterans Administration prosthetics representatives. In the future these schools, together with a third being considered at a new project just established in Chicago under Northwestern University, may become centers where local limb and brace makers, and perhaps medical students and others in the various para-medical categories, may become more familiar with the latest advances in modern prosthetics service.

The Committee on Prosthetics Education and Information is also concerned about what kinds of information can help spread the word. There already exists the Board's journal *Artificial Limbs* sent free twice a year under the provisions of Public Law 729 to a mailing list of upwards of 5,000 doctors, therapists, prosthetists, and others concerned with amputee rehabilitation. Documentary films, special technical papers and reports from the various program projects, as well as monographs and other scientific papers contributed by program specialists, all add up to a growing literature stemming from the activities sponsored by the Board.

A third committee has recently been added: that on Child Prosthetics Problems. While the Committees on Prosthetics Research and Development and on Education and Information are organized to cover all aspects of prosthetics from the cradle to the grave, there are many problems peculiar to the child amputee. Furthermore, the Children's Bureau, U. S. Department of Health, Education, and Welfare, and the crippled children's services of the various States require a different approach. The third Committee, therefore, must study the special needs and problems of the child amputee, one might say from conception to adulthood, and come up with appropriate recommendations.

Even before the evolution of the prosthetics program into an integrated pattern, the Michigan Crippled Children Commission had made important progress in the management of the child amputee, particularly at the Grand Rapids Mary Free Bed Hospital Clinic, since expanded through the aid of funds from the Children's Bureau to afford service throughout a number of neighboring States. As an outgrowth of consultation between the Commission and the Prosthetics Research Board's committees and with the support of additional research funds from the Children's Bureau, the California Crippled Children's Service has established at the Medical Center of the University of California at Los Angeles a Child Amputee Prosthetics Project to undertake broad research in areas not covered by the existing program projects at Berkeley, San Francisco, or Los Angeles. The Committees on Prosthetics Research and Development and on Prosthetics Education and Information, through the various program projects, will assist in carrying forward a coordinated effort which should result in better service to the child amputee throughout the country.

Other committees can be added as appropriate. At present the progress at the University of California Medical School in the medical problems of the amputee is coordinated through the Committee on Prosthetics Research and Development, which has strong medical representation. If it transpires that these investigations lead beyond the logical purview of this Committee, as well they may, a separate committee may be indicated. Again, the problem of the geriatric amputee may need special investigation. It is the present feeling of the Board, however, that further additions can await specific recommendations by the University of California Medical group or others concerned.

All this is merely a start. The prosthetic equipment now available, after 10 years of research, development, testing and application, though affording usable solutions for each type of amputee, is often sadly inadequate. The Committee on Prosthetics Research and Development, therefore, is faced with carrying a heavy assignment of items from the idea stage to manufacture and use. The "education" of the clinic team and the rehabilitation counsellor is just beginning. Training of the amputee is often neglected, almost never adequate. And these advances cost money and require the devoted services of many people of many skills and professional attainments. While in the complete "pie chart" of handicapped persons, sometimes said to be in

the order of 30,000,000 or more, we speak here of but a small sector, their need is great, deserving the best efforts of all disciplines and skills. Besides, in a world where, negatively, so much effort is devoted to destruction, or, positively, merely to the "pursuit of happiness," there is satisfaction in giving a little thought to a program of progress in prosthetics. At a time when somebody seems to be against almost everything, be it bad or good, it is gratifying to present a cause no one opposes.

# *SCIENCE NEWS*

## ANNUAL MEETING NATIONAL ACADEMY OF SCIENCES

The National Academy of Sciences will hold its ninety-fourth Annual Meeting at the Academy building, April 22–24. Sessions for the presentation of scientific papers will be held on Monday, April 22, and on Wednesday, April 24. A short business meeting will precede the first scientific session on Monday morning. The Sections of the Academy will meet late Monday afternoon after the scientific sessions. Tuesday, April 23, will be devoted to the election of officers and new members and to general Academy business. The scientific sessions will be open to the public.

In addition to the four scientific sessions of contributed papers there will be three symposia of invited papers. The subjects chosen for the symposia are genetics and radiation hazards, biological rhythms, and the physical properties of metals.

On Monday evening there will be a special program for the presentation of Academy medals. Each medalist will present a short address pertaining to his special field of scientific research. Following the formal presentations, there will be a reception for the medalists, members, and guests and a program of scientific demonstrations and exhibits. As in the past, Academy members and their associates will provide the exhibits with the view of demonstrating significant current scientific and technical advances.

The Academy dinner for members and guests will be held Tuesday evening, April 24, at the Hotel Statler. Immediately preceding the dinner, President and Mrs. Bronk will hold a reception for the members and their guests.

The customary buffet supper for members only will take place on Wednesday evening in the auditorium of the Academy building. This occasion will provide an opportunity for informal discussion of Academy policies and activities.

## NATIONAL ACADEMY OF SCIENCES IN VIENNA

As was previously reported, the National Academy of Sciences has been assisting in the placement of professional and other highly qualified personnel among the emigrees arriving at Camp Kilmer from Hungary. During the time this program has been operating approximately six hundred university trained persons have been interviewed.

It has become apparent that many of the displaced, professionally trained Hungarians in Vienna who desire to resettle in the United States are in need of assistance. This information came from representatives in Vienna and through official channels. Responding to this information and official welcome by the United States Embassy, the Academy has recently sent an exploratory group to Vienna to determine what contributions it might make in the interests of the proper use of the talents of displaced persons from Hungary and to assist in their relocation wherever they may wish to go, whether in the United States or elsewhere. The Academy group is led by Wallace W. Atwood, Jr., Director of the Office of International Relations. With him are Ralph E. Cleland, Dean of the Graduate School of Indiana University, and Richard T. Arnold, Program Administrator, Basic Science Program of the Alfred P. Sloan Foundation, Inc.

Preliminary information from the Academy Mission in Vienna indicates a substantial number of scientists from Hungary are in the capital and wish to come to the United States. These are being interviewed. The Immigration and Naturalization Service, which determines those who will be given entry permits to the United States, has indicated gratification with the assistance in evaluation given by the Academy group.

## CONFERENCE ON UNDERGRADUATE CURRICULA IN THE BIOLOGICAL SCIENCES

The Committee on Educational Policies of the Biology Council with its Subcommittee on College Education is sponsoring a conference on undergraduate curricula in the biological sciences. The conference, supported by a grant from the National Science Foundation, held its first meeting on December 8–9, 1956, and will complete its work in a 4-day session at the University of North Carolina in April. Willis H. Johnson, Wabash College, is chairman of the conference.

Recognition of the need for such a conference arose from correspondence and discussion between the Subcommittee on College Education and some five hundred American biologists, many of whom emphasized the need for an intensive, critical reexamination of courses and curricula.

The purpose of the conference is to develop a set of principles for planning biological courses and curricula for future biologists. The discussion centers around three questions: *1*) What biological knowledge should form part of the experience of all or most college students regardless of their course of study? 2) What additional knowledge and experience, in both biological and related fields, is essential, useful, or desirable for all biologists, irrespective of later specialization? 3) What is the role of the undergraduate college in providing specialized training, and what additional elements are basic in each of the major areas of specialization in biology?

A summary report will be published shortly after the April meeting and a detailed account of the discussions will be issued later in the year.

## CONFERENCE ON OCEANOGRAPHY

At the request of the Office of Naval Research, the Fish and Wildlife Service, and the Atomic Energy Commission, the Academy–Research Council held a Conference on Oceanography on February 19 as the first step toward the establishment of an advisory committee to assist and promote the advancement of the marine sciences. The following scientists, who were invited to provide guidance to the Academy–Research Council on the objectives and organization of the proposed group, attended the conference:

Harrison Brown, California Institute of Technology
Gifford C. Ewing, Scripps Institution of Oceanography
Richard H. Fleming, University of Washington
Harry H. Hess, Princeton University
John D. Isaacs, Scripps Institution of Oceanography
Columbus O'D. Iselin, Woods Hole Oceanographic Institution
Bostwick H. Ketchum, Woods Hole Oceanographic Institution
Dale F. Leipper, Texas Agricultural and Mechanical College
Daniel Merriman, Bingham Oceanographic Laboratory
Hilary B. Moore, University of Miami
Willard J. Pierson, Jr., New York University
Donald W. Pritchard, Chesapeake Bay Institute
Roger Revelle, Scripps Institution of Oceanography
Carl-Gustaf Rossby, Woods Hole Oceanographic Institution
William W. Rubey, U. S. Geological Survey
Milner B. Schaefer, Inter-American Tropical Tuna Commission
Oscar E. Sette, U. S. Fish and Wildlife Service
J. Lamar Worzel, Lamont Geological Observatory

In addition to the above scientists, the sponsoring governmental agencies and the appropriate Divisions of the Academy–Research Council were represented by staff members at the conference.

The conference deliberations indicated that the far-ranging activities which are included under oceanography create a great diversity of problems for the investigators and institutions concerned with the marine sciences. The most pressing problems lie in the spheres of recruitment and training, financial support for research facilities and students, coordination of data gathering and processing, and communication be-

tween the many fields within oceanography and the basic disciplines which might make greater contributions to marine research. The opportunities for greater understanding among bodies dealing with international aspects of oceanography were also emphasized.

The variety and complexity of the problems affecting progress in oceanography probably demand the attention of a diversified organization. The conference recommended that the Academy–Research Council appoint a small study group to devise an organization and designate functions suitable for attaining the objectives stated.

## LECTURE BY C. G. SUITS

The most recent lecture in the Academy–Research Council series was delivered by C. G. Suits, Vice President and Director of Research of the General Electric Company, on March 5, 1957. The title of the lecture was "Progress with Crystals."

Dr. Suits described some of the important and exciting advances which have been made in our knowledge of crystals—advances which have resulted in the development of materials having most unusual properties. Thus "perfect" iron crystals have been produced, having tensile strengths of more than 150 times that of ordinary iron crystals and 4 times that of the strongest steel wire. Such crystals also evaporate and dissolve only with great difficulty, do not oxidize readily, and have electrical and magnetic characteristics which are certain to be of practical importance.

In discussing the history of man's study of crystals and crystalline materials, Dr. Suits spoke of the different stages or phases of progress in this field. The gross structural characteristics of crystals were, of course, investigated first. Those properties of a material which depend primarily upon the gross structural characteristics of the material, such as density, compressibility, specific heat, etc., are now fairly well understood. In recent years interest has been focused on fine structure studies—studies of defect phenomena, dislocations and imperfections, and their effects. This has been another instance where theory has been far ahead of experiment for many years. At the present time theory satisfactorily accounts for a great variety of defects and defect phenomena. Only in recent years have experimentalists succeeded in "overtaking" the theoreticians. The experimentalists have made great progress in developing tools and techniques for conducting related studies. These include still and motion color microphotography, highly selective etching techniques, optical methods for studying the diffusion of one material into another, methods for producing high purity materials, methods for growing perfect crystals, and methods for producing certain types of defects and imperfections.

These theoretical and experimental studies have already been so fruitful, Dr. Suits concluded, that they have given us a new depth of understanding of crystals and their characteristics.

## INTERNATIONAL SYMPOSIUM ON MILITARY PSYCHOLOGY

At the request of the U. S. Air Force Air Research and Development Command, the Division of Anthropology and Psychology is organizing a two-day International Symposium on Military Psychology to be held in Brussels, Belgium, on July 26 and 27, 1957, immediately prior to the opening of the 15th International Congress of Psychology.

The symposium is being planned jointly by the Committee on International Relations in Psychology under the chairmanship of H. S. Langfeld, Professor Emeritus of Princeton University, and by the Committee on Military Psychology under the chairmanship of W. A. Hunt of Northwestern University. An international committee with Frank A. Geldard of the University of Virginia as chairman is arranging the symposium program which will consist of papers on military psychological research topics by representative psychologists from several Western European countries, the United Kingdom, and the United States.

Professor Geldard, who is spending this year as U. S. Office of Naval Research Scientific Liaison Officer in London, will also serve as general chairman of the symposium.

## ADVISORY BOARD ON EDUCATION

The Advisory Board on Education was created by action of the Governing Board of the Academy–Research Council in the spring of 1956 to carry out the following objectives:

1) To serve as the principal agent of the Academy–Research Council in broad matters affecting or relating to education in the sciences and to provide an effective instrument for the discharge of Academy responsibilities to government, science, and the public welfare.
2) To stimulate and encourage activity in all branches of engineering and the sciences to the end of making knowledge available to forms useful and logical for all levels of education.
3) To provide leadership in establishing scholarly criteria in science education.
4) To promote common planning among, to cooperate with, and otherwise assist professional organizations and societies in activities directed towards the improvement of education.
5) To join with other organizations and institutions in strengthening and maintaining the subject matter preparation of teachers at all levels of science education.
6) To anticipate future national requirements for scientific manpower and to relate these to all levels of science education.
7) To investigate and work toward the improvement of aids that science may bring to education including the media of television, radio, and films; to solicit the cooperation of industry and scientific bodies for this purpose.
8) To provide bridges between sciences and the other learned professions in matters of education in order to promote understanding and mutual purpose and to develop responsible, continuing cooperation among public schools, institutions of higher education, and industry.

Membership of the Board is made up of representatives of each division of the National Research Council as follows:

MAYNARD M. BORING, Consultant on Manpower, General Electric Company (Engineering and Industrial Research), *Chairman*
FRANCIS BITTER, Massachusetts Institute of Technology (Physical Sciences)
STEWART S. CAIRNS, University of Illinois (Mathematics)
THOMAS B. NOLAN, U. S. Geological Survey (Office of Scientific Personnel)
HOWARD M. PHILLIPS, Emory University (Biology and Agriculture)
CHALMER J. ROY, Iowa State College (Earth Sciences)
J. C. WARNER, Carnegie Institute of Technology (Chemistry and Chemical Technology)
DAEL WOLFLE, American Association for the Advancement of Science (Anthropology and Psychology)
W. BARRY WOOD, JR., Johns Hopkins University (Medical Sciences)

Since the original appointment of the Board, George R. Harrison of the Massachusetts Institute of Technology, who was the first representative of the Division of Physical Sciences, has requested relief for reasons of health.

In the six meetings which have been held various programs have been investigated and considered. Some of the more important actions taken by the Board are:

1) The provision for the continuation of the Arlington Plan, a community-supported program which provides course offerings by colleges and universities in the Washington area especially designed for secondary school teachers of science and mathematics.
2) The organization of a conference in New York in July 1956 on educational TV and its potential in the light of increased school and college enrollments.
3) The establishment of an Advisory Committee with M. H. Trytten as chairman to assist Harvey White of the University of California at Berkeley in his full course in physics being given this year over TV in the Pittsburgh Public Schools.
4) Study of pending or proposed federal legislation affecting education in the sciences.
5) The co-sponsorship of a conference with the American Association for the Advancement of Science and the Engineering Manpower and Scientific Manpower Commissions dealing with the problems of increased college enrollments on science and engineering faculties and facilities.
6) The organization with the cooperation of the Hughes Aircraft Company of a summer conference of school officials and representatives of industry in Southern California in 1957 to acquaint them with the programs to improve science teaching tried in other regions of the country and to make them aware of the resources available in their communities.
7) An evaluation of teaching films in mathematics, now in the planning stage.

The Carnegie Corporation of New York has granted the Advisory Board $50,000 for the calendar year 1957 to help carry out its various responsibilities. It is expected that this sum will be supplemented by private grants from industries in concurrence with the objectives of the Board and desirous of aiding their attainment.

## LECTURE BY C.-G. ROSSBY

On February 19, C.-G. Rossby, Director of the Institute of Meteorology, University of Stockholm, delivered the fifth lecture in the Academy–Research Council series on

the subject of "The Earth's Radiation Balance and the Deep Sea Circulation."

One of the most puzzling problems that confronts the geophysicist, according to Dr. Rossby, is that of the role of ocean as a heat reservoir. It has long been assumed that the incoming and outgoing radiation from the earth are in balance, but there is some question about the mechanism which maintains this balance. The atmospheric engine is driven by the difference between the effective solar radiation, which varies widely, and the outgoing radiation which is constant in all latitudes.

Sir George Simpson, the English meteorologist, believed that only the amount of cloudiness could change the situation and he suggested that the earth simply "pulls a curtain of clouds" to maintain the balance in such a way that it never radiates more heat but simply accepts less. It is instructive to calculate the amount of heating that would result if the effective incoming radiation were raised one percent per year. This would raise the temperature of the atmosphere 6.5° C. or the upper kilometer of ocean by 0.015° C. Any such rise in the atmospheric temperature could be easily observed, but is not; so apparently the atmosphere is not an important heat reservoir. It is evident, though, that enormous amounts of heat can be stored in the oceans without being noticed simply because it adds so much mass to the heat system. But it may be that the ocean can respond in a much more sophisticated manner.

If one examines the oceanic temperature measurements at the 4,000 meter level and traces the water masses by means of their oxygen content, it appears that there is a circulation cycle of 300 to 500 years. (Cold water generated in the higher latitudes sinks, warm water flows in on the surface and is mixed by convective turbulence.)

There is small probability that a process with a time scale of 300 to 500 years would ever reach a steady state. It would tend to be oscillating between periods of marked temperature differences between upper and lower layers and periods of small temperature differences.

Additional basic measurements are needed to develop these ideas. It is particularly important that the earth's albedo be measured by the satellite and that international groups make an effort to obtain deep temperature measurements on a continuing basis at many places in the ocean.

## INTERNATIONAL CONFERENCE ON RADIO-ISOTOPES IN SCIENTIFIC RESEARCH

An International Conference on Radio-Isotopes in Scientific Research will be held in Paris, September 16–27, 1957. This conference is being convened by Unesco, after consultation with the United Nations Secretariat and interested specialized agencies, in particular the World Health Organization, the United Nations Food and Agriculture Organization, and the World Meteorological Organization.

Although the expression "radio-elements" is more correct, the term "radio-isotopes" was retained in the title of the conference as being more widely used. The conference will be devoted primarily to the exposition and discussion of new ideas or methods for the utilization of radio-isotopes in scientific research. Nevertheless, new ideas concerning the production of radio-isotopes may be discussed. Similarly, it will be possible to deal with recent progress in measuring techniques calculated to facilitate the use of radio-isotopes. Problems relating to the use of stable isotopes will only be dealt with when they are presented in comparison with a similar use of radio-isotopes. Radiations produced by machines (particle accelerators, etc.) will only be discussed by analogy.

Only strictly scientific papers dealing with original research will be accepted for presentation. Neither the use of radio-isotopes for purely technical or economic purposes, nor their application in diagnosis or in medical treatment, come within the purview of the conference; this also applies to research in the field of genetics, where artificial sources of radiation are more usually employed. In the engineering sciences, discussion will be limited to new research methods in which isotopes are used.

Further information may be obtained from Unesco, Radio-isotopes Conference, 19 avenue Kléber, Paris 16, France.

## CONFERENCE ON EDUCATION, TRAINING, AND UTILIZATION OF SANITARY ENGINEERS

At the request of the U. S. Public Health Service, a two-day conference was held on March 6 and 7 by the Division of Medical Sciences to discuss the education, training, and utilization of sanitary engineers. Earnest Boyce, University of Michigan, served as chairman of the conference, which was held under the auspices of the Subcommittee on Personnel and Training of the Committee on Sanitary Engineering and Environment.

The conference opened with a review of present educational practices and went on to consider various proposals for changes in the standard undergraduate and graduate curricula and for specialized programs at the graduate level. Discussions of the most effective means of utilizing sanitary engineers in their several fields—public health, consulting practice, industry, military service, and public works—provided a vantage point for a critical attempt to assess manpower requirements in these areas. Lastly, the group turned to questions of stimulating public interest, recruitment, and provisions for in-service training. The conclusions and recommendations of the conference, which were adopted in principle at the closing session, will be presented in final form in a report to the U. S. Public Health Service at a later date.

## LECTURE BY RICHARD W. PORTER

The fourth lecture in the Academy–Research Council series was delivered by Richard W. Porter, Engineering Consultant for the General Electric Company and Chairman of the Technical Panel on the Earth Satellite Program, U. S. National Committee for the International Geophysical Year, on February 5. Speaking on the "Current Status of the U. S. Earth Satellite Program for the International Geophysical Year," Dr. Porter reviewed the progress made to date on the characteristics of the satellite and its launching vehicle and described a number of experiments to be conducted with the satellite.

He outlined the steps leading to the development of a satellite program by the U. S. National Committee as well as the organization of the United States' effort, naming the various agencies both governmental and private that are contributing to the success of the project.

The extensive radio and tracking systems are expected to determine the orbit of the satellite and to provide information on geodetic determinations, air density, and the composition of the earth's crust.

Further scientific data will be telemetered from satellite-borne instruments, Dr. Porter said. Four "hard-core" experiments depending on instruments carried in the satellite itself are currently planned. The first experiment concerns the measurement of ultraviolet radiation from the sun at the Lyman alpha line; the second is an experiment to measure the earth's magnetic field; the third, a cosmic ray experiment; and the fourth, an experiment to measure the terrestrial energy balance, that is the energy received from and given off by the earth to its environment.

In summary, Dr. Porter said that the organization of the program is complete; the designs have been frozen for the satellite, its boosters, and the instrumented experiments as well as for the optical and radio tracking networks; procurement is about on schedule with one or two exceptions; and the test firing program has begun. Based on the relatively complete design data now available, it appears that the performance will be at least as good as planned and that an impressive series of scientific experiments can be carried out using these vehicles.

## JOINT COMMITTEE ON UNION LIST OF SERIALS

The Joint Committee on the Union List of Serials, composed of representatives from the Academy–Research Council, the Library of Congress, and numerous scholarly and library societies in the United States, announces that the Rockefeller Foundation has made a grant of $6,000 to the Library of Congress to permit the Joint Committee to develop a new union-list program.

The general goal is to establish at the Library of Congress a permanent Union Catalog of Serials, from which union lists of various kinds—alphabetical, subject, country or region, etc.—can be produced systematically by punched-card techniques. Wyllis E. Wright, Librarian of Williams College, will carry out the basic investigations at the Library of Congress. The Joint Committee feels that the proposed Union Catalog of Serials will contribute substantially to the control of scientific serial literature throughout the United States.

## INTERNATIONAL COMMITTEE ON LABORATORY ANIMALS

The world demand for laboratory animals continues to increase enormously, especially for uniform high quality and specialized strains. Unless proper steps are taken, it is certain that vital progress in experimental biology and medicine will be delayed or hindered. In addition to numerous national problems of laboratory animal supply and use, there are many of a universal nature which can best be solved on a coordinated international basis. Therefore, consultants on laboratory animals, convened by Unesco on December 3 and 4, 1956, in Paris, recommended the formation of an International Committee on Laboratory Animals.

The international committee was established under the auspices of the International Union of Biological Sciences (IUBS), Unesco, the Council for International Organizations of Medical Sciences (CIOMS), the International Union of Physiological Sciences, the International Union of Biochemistry, and the International Union against Cancer. The committee was formed from a reorganization of the IUBS Committee on Laboratory Animals established in Rome in April 1955 and from a program established by Unesco based on recommendations of the Cell Biology Program of CIOMS made in December 1955.

The composition of the International Committee on Laboratory Animals is as follows:

Sven O. Hörstadius, President of IUBS and its representative on the committee, *Chairman*
W. Lane-Petter, Medical Research Council of the United Kingdom, *Honorary Executive Secretary*
Dale W. Jenkins, National Academy of Sciences—National Research Council of the United States
M. M. Sabourdy, Centre National de la Recherche Scientifique of France
A representative of CIOMS, yet to be appointed
A representative of Unesco, yet to be appointed.

The Committee is presently surveying the laboratory animal sources and utilization in the United Kingdom, the Benelux countries, France, Italy, and Scandinavia, including Finland and Iceland. Additional countries will be surveyed in the near future. The Committee is patterning its activities on an international scale after the programs of the Laboratory Animals Bureau of the Medical Research Council of the United Kingdom and the Institute of Laboratory Animal Resources of the Academy–Research Council. It is attempting to stimulate formation of similar organizations in other countries.

In order to improve the supply and quality of laboratory animals, an international survey is being made of *a*) the sources of supply, numbers, and kinds of laboratory animals produced or procured and *b*) the main users, the numbers and kinds of laboratory animals utilized, and the purposes for which they are used. A world list of strains of laboratory animals is being compiled, and a documentation center will be established.

The major problems of laboratory animals—supply, genetics, disease, nutrition, care, and transportation—are being studied. The requirements for international or local production centers for breeding and supplying inbred and other needed strains of laboratory animals (e.g. cancer susceptible mice) will be determined. A survey is also being made of establishments and facilities that could undertake these functions if needed.

The committee will also determine the need for establishing an information exchange, an educational program for animal technicians and caretakers, internationally recognized standards for laboratory animals, and systems for certifying animals and accreditation of suppliers.

### STAFF APPOINTMENTS

**Richard W. Rumke** joined the staff of the Committee on Ship Steel and the Committee on Ship Structural Design as a staff engineer on March 1. Before coming to the Academy–Research Council, Mr. Rumke was employed by the Southern Railway Company, where he worked in engineering design.

The Building Research Advisory Board has announced the appointment of **Francis Govan** as staff engineer for the Federal Construction Council to replace **Scott Heider,** who resigned to join the firm of Beasley and Beasley, Engineers-Appraisers, in Washington, D. C. For the past 8 years, Mr. Govan, who holds a B. S. degree in mechanical engineering from the U. S. Merchant Marine Academy, has been associated with the Washington Gas Light Company as fuel application engineer, industrial engineer representative, and laboratory engineer.

**Thomas Bradley,** formerly a Professional Associate, has been named Acting Executive Officer of the Division of Medical Sciences to fill the vacancy left by the resignation of **Philip S. Owen.** Dr. Owen, who had been a staff member of the Division since 1943 and Executive Officer since 1947, resigned because of persistent ill health. Dr. Bradley will be in charge of the Division's affairs during the Chairman's 3-month sojourn in Japan with the Atomic Bomb Casualty Commission.

The Maritime Cargo Transportation Conference has announced the appointment of **Samuel L. Walton, Jr.,** as staff analyst, effective February 1. Mr. Walton came to the Academy–Research Council directly from Georgetown University where he obtained his B.S. degree in foreign service. He obtained his B. S. degree in chemical engineering from Grove City College in 1952 following which he spent three years with the U. S. Army.

## *FELLOWSHIP PROGRAMS*

### RESEARCH ASSOCIATESHIPS IN MATHEMATICS

The Office of Naval Research (ONR) has announced the award of six postdoctoral research associateships in mathematics for the academic year 1957–58. As in the past these awards were made upon the recommendation of the Committee on Mathematics Advisory to ONR. The recipients of the research associateships are given below, together with the specific field of research and the institution making the appointment:

Goro Azumaya (Ph. D., Nagoya University, 1949)
Algebra number theory—Yale University

Edgar H. Brown, Jr., (Ph. D., University of Chicago, 1954)
Topology—Brown University

William L. Hoyt (Ph. D., Candidate, University of Chicago, 1957)
Algebraic geometry—Johns Hopkins University

George R. Livesay (Ph. D., University of Illinois, 1952)
Topology—Cornell University

Dock Sang Rim (Ph. D., Candidate, University of Indiana, 1957)
Algebraic number theory—Columbia University

Nobuo Yoneda (Ph. D., Candidate, Princeton University, 1957)
Topology—Columbia University

### FELLOWSHIPS IN THE NATURAL SCIENCES

Two postdoctoral fellowships in the natural sciences have been awarded for 1957–58. These fellowships are supported by Merck and Company and are administered by the Academy–Research Council.

The predoctoral fellowship, established by Leeds and Northrop Company and administered by the Academy–Research Council, was awarded this year in the field of chemistry. The predoctoral fellowship

awarded last year in the field of physics was renewed. A new predoctoral fellowship, established by the Institute of Radio Engineers and administered by the Academy–Research Council, was awarded for the first time for the academic year 1957–58.

The following list indicates the institution from which the recipient received his degree as well as the nature and location of his fellowship research:

**Merck Senior Postdoctoral Fellows**

William George Hoekstra (Ph. D., University of Wisconsin, 1954)
Research on the metabolism and possible site of action of estrogenic compounds through use of radioactive isotopes—National Institute for Research in Dairying in Shinfield, England, with R. F. Glascock

Raphael Rooser Ronkin (Ph. D., University of California at Berkeley, 1949)
Research on metabolic cycles in cells and on the chemistry and physiology of cells in relation to body size—University of Copenhagen, with Erik Zeuthen

**Leeds and Northrop Predoctoral Fellows**

David Adler (B. S., Rensselaer Polytechnic Institute, 1956)
Quantum mechanics and theoretical nuclear physics—Harvard University, with Edwin C. Kemble (renewal)

David W. Osborne (to receive B. S. in June 1957, Colorado College)
Polymer chemistry—University of Delaware

**Institute of Radio Engineers Predoctoral Computer Fellow**

Eugene W. Henry (M.S., Notre Dame, 1955)
Advanced training and research in servomechanism electronics—Stanford University

## FELLOWSHIP AWARD IN PHYSIOLOGICAL PSYCHOLOGY

Only one senior postdoctoral fellowship in physiological psychology has been awarded for the academic year 1957–58. This award is supported by the Carnegie Corporation of New York and administered by the Academy–Research Council. The recipient of this fellowship is given below:

Robert A. McCleary (M. D., Johns Hopkins University, 1947; Ph. D., Johns Hopkins University, 1951)
Acquisition of special techniques in neurophysiology to extend current experiments on brain function and behavior—University of Oslo, with Jan Jansen.

## NATIONAL SCIENCE FOUNDATION FELLOWSHIPS

For the sixth year the Fellowship Office of the Academy–Research Council has assisted the National Science Foundation (NSF) by receiving and evaluating applications for graduate and postdoctoral fellowships. The awards were announced by the Foundation on March 15.

There were 3,028 applications for graduate fellowships. The eight Graduate Fellowship Evaluation Panels met at the National Academy of Sciences, February 19–21, and the final NSF Graduate Evaluation Board met on February 22. The Board recommended 1,006 applicants to the Science Foundation and 845 received awards. Of these 216 awards were made in the life sciences (including anthropology and psychology), 615 in the physical sciences (including engineering and mathematics), and 14 in convergent fields.

There were 396 applications for postdoctoral fellowships. The preliminary screening was done by the Academy–Research Council Divisional Committees during January. Their reports were prepared for and presented to the NSF Postdoctoral Fellowship Evaluation Board which met on February 20. This Board recommended 103 candidates, 84 of whom were awarded postdoctoral fellowships. Of these, 33 were awarded in the life sciences, 50 in the physical sciences, and 1 in convergent fields.

## RESEARCH ASSOCIATESHIPS IN NATURAL SCIENCES

The Fellowship Office of the Academy–Research Council has again received and reviewed applications for research associateships at Argonne National Laboratory, the National Bureau of Standards, and the Naval Research Laboratory. This year for the first time the Fellowship Office has also processed the applications for Oak Ridge National Laboratory. At its meeting on March 10, the Postdoctoral Fellowship Board in the Natural Sciences reviewed 47 applications and certified 13 candidates to Argonne National Laboratory, 10 to Oak Ridge National Laboratory, 15 to the National Bureau of Standards, and 6 to the Naval Research Laboratory.

# *RECORD OF MEETINGS*

**January**

3–5 Committee on Child Development, *Iowa City*
4 Panel on Plasma, *Cambridge, Mass.*
Federal Construction Council, Task Group on Proposed Investigation of Multiple Panel Reinforced Concrete Floors for Buildings
5 Committee Advisory to the Atomic Bomb Casualty Commission
7–8 Mine Advisory Committee, *Panama City, Fla.*
7–11 Highway Research Board, Annual Meeting
8 Panel on Industrial Diamonds
9–10 Special Advisory Committee on the Use of Grade Boards in Individual Sewage Disposal Fields
10 Advisory Board on Education
Advisory Board on Quartermaster Research and Development, *Natick, Mass.*
Federal Construction Council, Operating Committee
11 Committee on Geography, Advisory to the Department of State
Subcommittee on Vector Control
11–12 Biology Council, Subcommittee on Precollege Education, Teacher Recruitment, and Teacher Education
12 National Advisory Committee for the AASHO Road Test
12–13 Committee on Postdoctoral Fellowships in Mathematics
13–14 Biology Council, Subcommittee on Applied Biology and Technical Specialists, *Chicago*
14–15 Committee on Ship Structural Design, *Old Point Comfort, Va.*
Biology Council, Subcommittee on Graduate and Professional Education
Committee on Postdoctoral Fellowships in Biology and Agriculture
15 Sub-panel on Titanium Sheet Rolling
16 Building Owners Program Committee
International Conference on Scientific Information, Executive Division
16–17 Panel on Titanium Sheet Rolling
17–18 Special Advisory Committee on Inverted Crown Streets and Alleys, *Los Angeles*
18 Planning Conference for Use of Computers in Biology and Medicine
18–20 Biology Council, Subcommittee on College Education, *St. Louis*
19–20 Committee on Postdoctoral Fellowships in Anthropology and Psychology
21–23 Committee on Drug Addiction and Narcotics, *Indianapolis*
22 Building Research Institute, Program Subcommittee for Sixth Annual Meeting
23 Committee on International Exchange of Persons, Subcommittee on Planning and Development and Board of Foreign Scholarships, Joint Meeting

**January**

23–24 Committee on Postdoctoral Fellowships in Chemistry and Chemical Technology
24 Committee on Feed Composition, *New York City*
Committee on Foods, Subcommittee on Radiation Preservation, *Gatlinburg, Tenn.*
25 Committee on Astronomy, Advisory to the Office of Naval Research
25–26 Committee on Postdoctoral Fellowships in the Medical Sciences
Subcommittee on Radiobiology Conference on Genetics and Radiology
27–29 Committee on Postdoctoral Fellowships in the Physical Sciences
28 Institute of Laboratory Animal Resources, Governing Board
29 Subcommittee on the Cardiovascular System
29–30 Committee on Toxicology
30 USA National Committee of the International Union of Pure and Applied Physics, *New York City*
Ad hoc Committee on Contract Evaluation on a Electron Accelerator, *New York City*
Building Research Institute, Board of Governors
31 Subcommittee on Shock and Panel on Plasma, Joint Meeting

**February**

1 Committee on Fire Research, *Cambridge, Mass.*
Ad hoc Conference on USA National Committee for International Institute of Refrigeration
Subcommittee on Shock and Subcommittee on Trauma, Joint Meeting
Sub-panel on Alloy Steels
1–2 Committee on Regional Development of Mathematics, *New York City*
2 Division of Earth Sciences, Executive Committee
USA National Committee for the International Mathematical Union
3 National Academy of Sciences—National Research Council, Governing Board
4 Highway Research Board, Steering Committee on Urban Research
5 Organizing Committee for Proposed International Conference on Systemic Pesticides
5–6 Committee on Containers, *Chicago*
Panel on Blood Coagulation
7 Building Research Institute, Planning Committee for Plastics Study Group
Panel on Transfusion Problems
Earth Satellite Technical Panel
8 Subcommittee on Blood and Related Problems

**February**

8 Subcommittee on Biological Control of Soil-Borne Plant Pathogens

9 Ad hoc Panel on Establishment of a Hemoglobin Standard

Ad hoc Conference on USA National Committee of International Institute of Refrigeration, Finance Subcommittee

13 National Science Foundation Senior Postdoctoral Fellowship Evaluation Committees for Physical and Biological Sciences

Federal Construction Council, Operating Committee

14 National Science Foundation Senior Postdoctoral Fellowship Evaluation Board

14–15 American Geophysical Union, Pacific Southwest Regional Meeting, *Sacramento*

15 Subcommittee on Food Sanitation

Agricultural Board, Executive Committee

USA National Committee for the International Geophysical Year, Executive Committee

Materials and Construction Technical Panel for the AASHO Road Test

15–17 Biology Council, Subcommittee on College Education

16 Committee on Radiology

18 National Science Foundation Final Graduate Evaluation Panel

19 Committee on Oceanography

Project Advisory Committee on Welded Crack Arrestors

**February**

19 Division of Earth Sciences, Conference on Oceanography

19–21 National Science Foundation Graduate Fellowship Evaluation Panels for Anthropology and Psychology, Biological Sciences, Chemistry, Convergent Fields, Earth Sciences, Engineering, Mathematics, and Physics and Astronomy

20 National Science Foundation Postdoctoral Fellowship Evaluation Board

20–21 Sub-panel on Titanium Sheet Rolling, *Pittsburgh*

Building Research Advisory Board

21 Ad hoc Committee to Review Proposed Study on the Role of Heredity in Disease as Determined by Studies on Veteran Twins

22 National Science Foundation Final Graduate Evaluation Panel

Committee on Mathematics Advisory to the Office of Naval Research, *New Haven, Conn.*

25–26 Mine Advisory Committee, *New Haven, Conn.*

27 Food Protection Committee

27–28 Building Research Institute Architectural Specifications Workshop

28 Organizing Committee for Proposed International Conference on Systematic Pesticides

Committee on Foods, Ad hoc Subcommittee on High Level Dosimetry, *Chicago*

# *NEW PUBLICATIONS*

American Geological Institute. *Departments of Geological Sciences in Educational Institutions of the United States and Canada, 1956–57.* Washington, 1957. (AGI Report 11, 1956–57 edition.) 196 p. $1.50.

Bascom, Willard. *A National Attack-Warning System.* Washington, NAS, Advisory Committee on Civil Defense, 1956. 44 p.

Bascom, Willard. *A Proposed Home Shelter.* Washington, NAS, Advisory Committee on Civil Defense, 1956. 13 p.

Bujes, J. I. *Development of Filmless Technique for Recording Defects in Ship Welds.* Washington, NAS–NRC, Ship Structure Committee, 1957. (Serial No. SSC–104.) 35 p., illus.

Conference Board of Associated Research Councils. Committee on International Exchange of Persons. *U. S. Government Awards under the Fulbright and Smith-Mundt Acts, 1958–59, University Lecturing, Advanced Research. Argentina, Australia, Burma, Chile, Colombia, Ecuador, India, New Zealand, Pakistan, Peru, Philippines, Thailand. 1957–58 Interim Programs, Argentina, Israel, Turkey.* Washington, 1957. 44 p.

Harmon, Lindsey R. *Fellowships Selection Research, a Four-Year Progress Report.* Washington, NAS–NRC, Office of Scientific Personnel, 1957. 37 p.

Killian, Lewis M. *An Introduction to Methodological Problems of Field Studies in Disasters, a Special Report . . .* Washington, NAS–NRC, Committee on Disaster Studies, 1956. (NAS–NRC Publication 465. Committee on Disaster Studies, Disaster Study No. 8.) 35 p. $0.75.

Klopsteg, Paul E. *Instrumentation in Bio-Medical Research.* Washington, NAS–NRC, Biology Council, 1957. (NAS–NRC Publication 472.) 14 p. $0.75.

National Research Council. Building Research Institute. *Modern Masonry, Natural Stone and Clay Products . . .* Washington, 1956. (NAS–NRC Publication 466.) 163 p., illus. $4.50.

National Research Council. Building Research Institute. *Register of Members, January 1957.* Washington, 1957. 41 p.

National Research Council. Committee on a National Atlas of the United States. *Preliminary List of Desirable Maps for the National Atlas of the United States.* Washington, 1957. 5 p.

National Research Council. Committee on Animal Nutrition. *The Need for an Expanded Research Program on the Quantitative Nutrient Requirements of Domestic Animals.* Washington, 1957. 5 p.

National Research Council. Committee on Animal Nutrition. Subcommittee on Dairy Cattle Nutrition. *Nutrient Requirements of Domestic Animals. Number III, Nutrient Requirements of Dairy Cattle, Revised 1956.* Washington, 1956. (NAS–NRC Publication 464.) 30 p., illus. $1.00.

National Research Council. Committee on Undersea Warfare. Panel on Underwater Swimmers. *Status of Research in Underwater Physiology, March 1956* . . . Washington, 1956. (NAS–NRC Publication 468.) 24 p. $1.00.

National Research Council. Conference on Glossary of Terms in Nuclear Science and Technology. *A Glossary of Terms in Nuclear Science and Technology.* New York, American Society of Mechanical Engineers, 1957. (ASME 110–1957.) 188 p. $5.00.

National Research Council. Food Protection Committee. *Safe Use of Pesticides in Food Production. A Report* . . . Washington, 1956. (NAS–NRC Publication 470.) 16 p. $0.50.

National Research Council. Highway Research Board. *Factors Influencing Ground Freezing* . . . Washington, 1956. (NAS–NRC Publication 425. Highway Research Board Bulletin 135.) 165 p., illus. $3.40.

National Research Council. Highway Research Board. *The Field of Highway Safety Research, a Brief Outline Revised August 1952; and Highway Safety Research Correlation Conference, June 5 and 6, 1952.* Washington, 1956. (NAS–NRC Publication 454.) [variously paged]. $1.50.

National Research Council. Highway Research Board. *Flexible Pavement Design in Four States* . . . Washington, 1956. (NAS–NRC Publication 427. Highway Research Board Bulletin 136.) 58 p., illus. $1.00.

National Research Council. Highway Research Board. *Glossary of Pedologic (Soils) and Landform Terminology for Soil Engineers.* Washington, 1957. (NAS–NRC Publication 481. Highway Research Board Special Report 25.) 32 p. $0.80.

National Research Council. Highway Research Board. *Joint and Crack Sealing* . . . Washington, 1956. (NAS–NRC Publication 429. Highway Research Board Bulletin 138.) 24 p., illus. $0.60.

National Research Council. Highway Research Board. *Median Design: Effect on Traffic Behavior* . . . Washington, 1956. (NAS–NRC Publication 428. Highway Research Board Bulletin 137.) 26 p., illus. $0.60.

National Research Council. Highway Research Board. *Pressure-Deformation Measurements in Earth.* Washington, 1956. (NAS–NRC Publication 433. Highway Research Board Bulletin 141.) 53 p. $1.00.

National Research Council. Highway Research Board. *Right-of-Way* . . . Washington, 1956. (NAS–NRC Publication 432. Highway Research Board Bulletin 140.) 83 p. $1.60.

National Research Council. Highway Research Board. *Road Roughness and Slipperiness, Some Factors and Test Methods* . . . Washington, 1956. (NAS–NRC Publication 431. Highway Research Board Bulletin 139.) 84 p., illus. $1.60.

National Research Council. Maritime Cargo Transportation Conference. *Roll-on, Roll-off Sea Transportation. Proceedings of the Symposium, 19 November 1956, Washington, D. C.* Washington, 1957. (NAS–NRC Publication 471.) 49 p. $1.25.

## *Notice of Academy Meetings*

NATIONAL ACADEMY OF SCIENCES

Annual Meeting, Washington, D. C., April 22–24, 1957

Autumn Meeting, New York City, November 11–13, 1957

NATIONAL ACADEMY OF SCIENCES—NATIONAL RESEARCH COUNCIL

Governing Board, Washington, D. C., June 16, 1957

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